REMARKS

This application has been reviewed in light of the Final Office Action of December 12, 2008. Claims 1-20 are pending. In the outstanding Office Action, the Examiner rejected claims 1, 3-6, 8-10, 12 and 14-19 under 35 U.S.C. § 102(b) as being anticipated by Kressel et al. (U.S. Patent No. 4,070,206) (hereinafter "Kressel et al."), and rejected claims 2, 11 and 13 under 35 U.S.C. § 103(a) as being obvious over Kressel et al. in view of Gibbons (U.S. Patent No. 3,718,502) (hereinafter Gibbons), and rejected claims 7 and 20 under 35 U.S.C. § 103(a) as being obvious over Kressel in view of Mann et al. (U.S. Patent No. 3,340,096) (hereinafter Mann et al.).

Reconsideration of this application is requested.

Response to Arguments

The Examiner states that

> Applicant argues that Kressel does not teach a shunt having an asymmetric current-voltage characteristic of passing a small current when voltage-biased in a forward direction parallel to the channel, and passing a large current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction. However, the Examiner respectfully disagrees. As seen in Figures 1, 3, 4-7, Kressel et al discloses a solar cell structure (10) comprising semiconductor layers (18, 22, 20 in Figures 1 and 3; 118, 120 and 122 in Figures 4-7) in facing contact with each other to form P-N junctions (24 and 26 in Figures 1 and 3; 124 and 126 in Figures 4-7- See col. 2 lines 33-49); a shunt (pocket regions 28 or 30 in Figures 1 and 3; 128 or 130 in Figures 4-7) comprises a channel of an altered material, wherein the altered material is highly doped material (see col. 3 lines 2-7) extending between and at least through two layers of semiconductor layers, and comprise a channel of altered material. (See Fig. 1, 3, and col. 3 lines 2-7). Because the shunt (or pocket regions 28 or 30) comprises altered material of highly doped material of either N or P conductivity and extending through P-N junction(s), therefore it is the Examiner's position that the shunt (or pocket regions 28 or 30) has an asymmetric current-voltage characteristic of passing a small current when voltage-bias in a forward direction parallel to the channel, and

passing a large current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction, particularly in view of the fact that the pocket regions of Kressel having doped altered material similar to the approach of how Applicant achieves a shunt with claimed characteristics. (See paragraph 008 of Applicant's specification).

Applicant respectfully disagrees with the Examiner's understanding of Kressel et al. As appreciated by one of ordinary skill in the art, the pocket regions of Kressel et al. collect current from the junctions between subcells. As shown in Figs. 2 and 5 of Kressel et al., the pocket regions are depicted as resistors. It will be appreciated by one of ordinary skill in the art that the pocket regions will form p-n junctions around themselves and act as diodes in parallel with the two existing diodes shown in Figs. 2 and 5. Since the pocket regions are in parallel (in the same direction) they will flow current when the cell is forward biased as they are designed to do, and will flow no current when the cell is in reverse bias (since they are diodes). Hence it provides no by-pass protection. The present disclosure differs in that the current flows through the shunts when the cell is reverse biased thereby providing by-pass protection, and passes no current when the cell is forward biased.

Rejection under 35 U.S.C. § 102(b)

Claims 1, 3-6, 8-10 and 14-19 are rejected under 35 USC 102(b) as anticipated by Kressel U.S. Patent 4,070,206.

Specifically, the Examiner stated

Regarding claims 1 and 3, as seen in Figures 1, 3, 4-7, Kressel et al discloses a solar cell structure (10) comprising semiconductor layers (18, 22, 20 in Figures 1 and 3; 118, 120 and 122 in Figures 4-7) in facing contact with each other to form P-N junctions (24 and 26 in Figures 1 and 3; 124 and 126 in Figures 4-7- See col. 2 lines 33-49); a shunt (pocket regions 28 or 30 in Figures 1 and 3; 128 or 130 in Figures 4-7) comprises a channel of an altered material, wherein the altered material is highly doped material (see col. 3 lines 2-7) extending between and at least through two layers of semiconductor layers, and comprise a channel of altered material. (See Fig. 1, 3, and col. 3 lines 2-7). Because the shunt (or pocket regions 28 or 30) comprises altered material of highly doped material of either N or P conductivity and extending through P-

N junction(s), therefore it is the Examiner's position that the shunt (or pocket regions 28 or 30) has a asymmetric current-voltage characteristic of passing a small current when voltage-bias in a forward direction parallel to the channel, and passing a large current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction, particularly in view of the fact that the pocket regions of Kressel having doped altered material similar to the approach of how Applicant achieves a shunt with claimed characteristics. (See paragraph 008 of Applicant's specification)

Regarding claim 4-5, Kressel et al disclose that the solar cell comprises more than two semiconductor layers, wherein the shunt (28 in Figures 1 and 3, 128 in Figure 7) extends between and at least partially through two of the semiconductor layers, and shunt (30 in Figures 1 and 3, 130 in Figures 4-7) extends between and at least partially through three of the semiconductor layers. (See Figures 1, 3 and 7).

Regarding claim 6, Kressel et al disclose that the solar cell comprises plurality of channels (or pocket regions 28 and 30) spaced apart from each other over a front-side surface of the solar cell. (See Fig. 1 and 3).

Regarding claims 8-10, as seen in Figures 1, 3 and 4-7, Kressel et al. teaches a method for fabricating a solar cell structure comprising the steps of depositing a solar cell comprising two or more semiconductor layers (18, 22 and 20 in Figures 1 and 3; 118, 122 and 120 in Figures 4-7) in facing contact with each other, wherein the semiconductor layers comprise a semiconductor junction (24 or 26 in Figures 1 and 3, 124 or 126 in Figures 4-7) producing a voltage between the two semiconductor layers when illuminated (See col. 4 lines 15-50 and Abstract), forming a shunt (or pocket regions 28 or 30) comprising a channel of an altered material extending between at least partially through at least two semiconductor layers (such as pocket region 28 in Figures 1 and 3, and 130 in Figure 7), or at least three of the semiconductor layers (such as pocket region 30 – See col. 4 line 51 to col. 5 line 13). Because the shunt (or pocket regions 28 or 30) comprises altered material of highly doped material of either N or P conductivity and extending through P-N junction(s), therefore it is the Examiner's position that the shunt (or pocket regions 28 or 30) has a asymmetric current-voltage

characteristic of passing a small current when voltage-bias in a forward direction parallel to the channel, and passing a large current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction, particularly in view of the fact that the pocket regions of Kressel having doped altered material similar to the approach of how Applicant achieves a shunt with claimed characteristics. (See paragraph 008 of Applicant's specification)

Regarding claim 12, Kressel et al. teaches the step of forming a shunt includes a step of doping the channel. (See col. 4 line 51 to col. 5 line 13)

Regarding claims 14-15, as seen in Figures 1, 3 and 7, Kressel et al teaches forming a plurality of channels (or pocket regions 28 and 30 in Figures 1 and 3, 128 and 130 in Figure 7) spaced apart from each other over a front side surface of the solar cell. Kressel et al. also teaches a photovoltaic device (or solar cell) is used to generate carriers by absorbing solar radiation (See Summary of Kressel et al.). Therefore it is the Examiner's position that Kressel et al. teaches a step pf placing the solar cell structure into service.

Regarding claim 16, as seen in Figure 6, Kressel et al. teaches the solar cell further comprises a front side metal grid (136) and a back side metallization (154).

Regarding claim 17, as seen in Figure 6, Kressel et al. disclose a solar structure comprising a solar cell 110 having two semiconductor layers 118 and 122 to form a pn junction 124, or two layers semiconductor layers 122 and 120 to form a pn junction 126, wherein the pn junction produces a voltage between the two semiconductor layers when illuminated; a front side metal grid 136 (See col. 5 lines 39-60); a back side metallization 154 (See col. 6 lines 23-25); a shunt (or pocket regions 128 and 130) comprising a channel of a doped altered material (heavily doped semiconductor, See col. 3 lines 2-7) extending between and at least partially through the two semiconductors. Pocket region 128 extends between and at least partially through the two semiconductors 118 and 122, and pocket region 130 extends between and at least partially through the two semiconductors 122 and 122. Because the shunt (or pocket regions 28 or 30) comprises altered material of highly doped material of either N or P conductivity and extending through P-N junction(s), therefore it is the Examiner's position that the shunt

(or pocket regions 28 or 30) has a asymmetric current-voltage characteristic of passing a small current when voltage-bias in a forward direction parallel to the channel, and passing a large current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction.

Regarding claim 18, Kressel et al. disclose the solar cell comprising three semiconductor layers 118, 120 and 122 (more than two semiconductor layers), wherein the shunt (or pocket regions 20 and 30) extend between and at least partially through at least two of the semiconductors layers. (See Figure 6)

Regarding claim 19, Kressel et al. disclose the shunt comprises a plurality of channels (pocket regions 128 and 130) spaced apart from each other over a front-side surface of the solar cell. (See Figure 6).

Applicant traverses this ground of rejection.

The following principle of law applies to §102 rejections. MPEP 2131 provides: "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. The identical invention must be shown in as complete detail as is contained in the ... claim. The elements must be arranged as required by the claim..." [citations omitted] This is in accord with the decisions of the courts. Anticipation under §102 requires 'the presence in a single prior art disclosure of all elements of a claimed invention arranged as in that claim.' Carella v. Starlight Archery, 231 USPQ 644, 646 (Fed. Cir., 1986), quoting Panduit Corporation v. Dennison Manufacturing Corp., 227 USPQ 337, 350 (Fed. Cir., 1985).

Thus, identifying a single element of the claim, which is not disclosed in the reference is sufficient to overcome a §102 rejection.

Claim 1 recites in part:

"a shunt...

having an asymmetric current-voltage characteristic of passing a small current when voltage-biased in a forward direction parallel to the channel, and passing a large current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction."

Similarly, independent claim 8 recites in part:

"forming a shunt …

having an asymmetric current-voltage characteristic of passing a small current when voltage-biased in a forward direction parallel to the channel, and passing a large current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction."

And furthermore, independent claim 17 recites in part:

"a shunt …

having an asymmetric current-voltage characteristic of passing a small current when voltage-biased in a forward direction parallel to the channel, and passing a large current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction."

Kressel et al., as understood, discloses a multilayered photovoltaic device including P-N junctions at the interface between adjacent layers. Kressel et al. further discloses a first pocket region 28 and a second pocket region 30 extending through a first P-N junction and a second P-N junction, respectively. Kressel et al. discloses that the pocket regions 28, 30 are a carrier transfer means for the device (see Kressel et al. col. 2 line 59 to col. 3, line 7).

Kressel et al., as admitted by the Examiner, does not explicitly disclose that the pocket regions have the characteristic of "having an asymmetric current-voltage characteristic of passing a small current when voltage-biased in a forward direction parallel to the channel, and passing a large current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction."

The explanation of the rejection seeks to negate this limitation with reference to case authority dealing with newly discovered use or function being “inherent in the prior art.” The Examiner’s position can be sustained only if it can be shown that the recited limitation is inherent in the approach of Kressel et al.

MPEP 2112-2113 sets forth the law on inherency. Inherency is not to be taken lightly and not to be asserted unless there is good evidence to suggest that the asserted property or characteristic is necessarily present in the teachings of the prior art reference. The concept of inherency is not provided as a way to fill in the gaps in missing disclosure or teachings based upon speculation, unless the asserted property or characteristic may be shown to be necessarily present by objective evidence. Instead, “inherency” is used when every aspect of the disclosure of a reference and the

claimed subject matter is otherwise exactly the same, then it may be inferred that some property or characteristic further recited in the claim must necessarily be present in the art reference. MPEP 2112 provides "The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. In re Rijckaert, 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993); In re Oelrich, 666 F.2d 578, 581-82, 212 USPQ 323, 326 (CCPA 1981). "To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.'" In re Robertson, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) (citations omitted). "In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." Ex parte Levy, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990)."

The Examiner's response is twofold. First, the Examiner argues that the recited limitation is "inherent," without providing any reasoning supporting this statement (Final Office Action, page 8, lines 9-14). Kressel does not disclose the claimed asymmetric characteristic anywhere, nor has the Examiner provided any pertinent argument that there would necessarily be any asymmetry in the voltage characteristics of Kressel et al. No location in Kressel et al. or any other source is identified that might have such a disclosure or lead to such a conclusion.

Second, the Examiner argues that "Applicant does not show any evidence to prove the prior art products do not necessarily possess the characteristics of the claimed product." (Final Office Action, page 8, lines 14-16.) The Examiner has misinterpreted the directives of MPEP 2112. It is the Examiner who must make the showing of inherency. MPEP 2112 provides: "In relying upon the theory of inherency, ***the examiner must provide a basis in fact and/or technical reasoning to reasonably support*** the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." [emphasis added]

In effect, the Examiner is attempting to read out the limitation of claim 1, "a shunt...having an asymmetric current-voltage characteristic of passing a small current when voltage-biased in a forward direction parallel to the channel, and passing a large

current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction" by arguing inherency without any basis for the argument.

The Examiner has mischaracterized Kressel et al. As appreciated by one of ordinary skill in the art, the pocket regions of Kressel et al. collect current from the junctions between subcells. As shown in Figs. 2 and 5 of Kressel et al., the pocket regions are depicted as resistors. It will be appreciated by one of ordinary skill in the art, that the pocket regions will form p-n junctions around themselves and act as diodes in parallel with the two existing diodes shown in Figs. 2 and 5. Since the pocket regions are in parallel (in the same direction) they will flow current when the cell is forward biased as they are designed to do, and will flow no current when the cell is in reverse bias (since they are diodes). Hence it provides no by-pass protection. The present disclosure differs in that the current flows through the shunts when the cell is reverse biased thereby providing by-pass protection, and passes no current when the cell is forward biased.

Furthermore, Kressel et al. at Figs. 2 and 5 and accompanying discussion, discloses a schematic diagram of the equivalent electrical circuit of the photovoltaic device as disclosed by Kressel et al. As can be seen in Figs 2 and 5, the equivalent circuits include no other unidirectional or other diode equivalent except for the P-N junctions. If, as the Examiner argues, the pocket regions inherently possessed the characteristics of a unidirectional device, such as a diode, such a device would be included in both Figs. 2 and 5. Since neither of Figs. 2 and 5 includes such a device equivalent, the photovoltaic device fails to meet this limitation.

Dependent claims 3-6, 9-10, 14-16, 18 and 19 are believed to be allowable as depending from what are believed to be allowable independent claims 1, 8 and 17 for the reasons given above. In addition, claims 3-6, 9-10, 14-16, 18 and 19 recite further limitations that distinguish over the applied art. In conclusion, it is respectfully submitted that claims 1, 3-6, 8-10 and 14-19 are not rendered obvious by Kressel et al. and are therefore allowable.

Applicant asks that the Examiner reconsider and withdraw the rejections.

(intentionally blank)

Rejections under 35 U.S.C. 103(a)

A. Claims 2, 11 and 13

The Examiner rejected claims 2, 11 and 13 under 35 U.S.C. § 103(a) under 35 U.S.C. § 103(a) as obvious over Kressel et al. in view of Gibbons.

Specifically, the Examiner stated

> Kressel et al disclose a solar cell structure and a method of fabrication as applied to claims 1, 3-6, 8-10, 12 and 14-19, wherein the channel (or pocket region 28 or 30) is highly doped with N or P conductivity by placing the semiconductor body into a diffusion furnace (See col. 4 lines 51 to col. 5 line 13).
>
> Kressel et al do not teach the altered material is a proton-irradiated altered material, nor do they specifically teach the steps of directing a proton beam into the semiconductor layers, doping the channel by ion implantation and annealing the channel.
>
> With respect to claim 2, Gibbons teaches irradiating semiconductor layers with proton to enhance the diffusion of P-type or N-type to a certain depth. (See col. 3 line 41 to col. 6 line 29). In such combination of Kressel et al. and Gibbons, it is the Examiner's position that the altered material (P- or N-type material) is proton-irradiated altered material.
>
> With respect to claim 11, Gibbons teaches directing a proton beam into the semiconductor layers to enhance the diffusion of atoms into the semiconductor layers. (See col. 3 line 41 to col. 6 line 29)
>
> With respect to claim 13, Gibbons teaches doping a semiconductor layer by ion implantation and annealing the material. (See col. 3 lines 41-67, col. 9 lines 1-56)
>
> It would have been obvious to one having ordinary skill in the art at the time of the invention was made to modify the structure of Kressel et al by having the altered material is a proton-irradiated altered material as taught by Gibbons because Gibbons teaches the proton irradiation would enhance the diffusion of dopant (P- or N-type; See Abstract of Gibbons and col. 3 line 41 to col. 4 line 66), and modify the method of Kressel et al. by directing a proton beam into the semiconductor or doping the channel

by ion implantation and annealing the channel as taught Gibbons, because Gibbons teaches the proton irradiation would enhance the diffusion of dopant (P- or N-type; See Abstract and col. 3 line 41 to col. 6 line 66) and the ion implantation followed by annealing the semiconductor material is one of several well known techniques in doping semiconductor material (See col. 3 lines 41-66 and col. 9 lines 1-56)

Applicant traverses this ground of rejection.

The following principle of law applies to all Section 103 rejections. MPEP 2143.03 provides "To establish prima facie obviousness of a claimed invention, all claim limitations must be taught or suggested by the prior art. In re Royka, 490 F2d 981, 180 USPQ 580 (CCPA 1974). All words in a claim must be considered in judging the patentability of that claim against the prior art. In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970)." [emphasis added] That is, to have any expectation of rejecting the claims over a single reference or a combination of references, each limitation must be taught somewhere in the applied prior art. If limitations are not found in any of the applied prior art, the rejection cannot stand. In this case, the applied prior art references, applied individually or combined, clearly do not arguably teach some limitations of the claims.

The teachings and limitations of Kressel et al. are discussed above.

Gibbons, as best understood, discloses a method of enhancing diffusion of selected atom species by proton bombardment. Gibbons provides no disclosure as to the characteristics of formed shunts in a photovoltaic device, and thus does not cure the deficiencies of Kressel et al. as discussed above as to the limitation that the shunt have an asymmetric current-voltage characteristic of passing a small current when voltage-biased in a forward direction parallel to the channel, and passing a large current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction.

Dependent claims 2, 11 and 13 are believed to be allowable as depending from what are believed to be allowable independent claims 1 and 8 for the reasons given above. In addition, claims 2, 11 and 13 recite further limitations that distinguish over the

applied art. In conclusion, it is respectfully submitted that claims 2, 11 and 13 are not rendered obvious by Kressel et al. in view of Gibbons and are therefore allowable.

Applicant asks that the Examiner reconsider and withdraw the rejections.

B. Claims 7 and 20

The Examiner rejected claims 7 and 20 under 35 U.S.C. § 103(a) under 35 U.S.C. § 103(a) as obvious over Kressel et al. in view of Mann et al.

Specifically, the Examiner stated

> Regarding claims 7 and 20, Kressel et al teaches a solar cell structure as applied to claims 1, 3-6, 8-10, 12 and 14-19.
>
> Kressel et al does not teach interconnecting solar cells.
>
> Mann et al. teaches interconnecting solar cells in series and parallel (See col. 1 lines 14-19).
>
> It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the structure of Kressel et al by electrically interconnecting plurality of solar cells of Kressel as taught by Mann et al., because Mann et al. teaches that the required voltage and current would be achieved by interconnecting the cells in series and parallel. (See col. 1 lines 14-19)

Applicant traverses this ground of rejection.

The teachings and limitations of Kressel et al. are discussed above.

Mann et al., as best understood, discloses a solar cell array including interconnecting solar cells in series and in parallel. Mann et al. provides no disclosure as to the characteristics of formed shunts in a photovoltaic device, and thus does not cure the deficiencies of Kressel et al. as discussed above as to the limitation that the shunt have an asymmetric current-voltage characteristic of passing a small current when voltage-biased in a forward direction parallel to the channel, and passing a large current when voltage-biased in a reverse direction parallel to the channel and opposite to the forward direction.

Dependent claims 7 and 20 are believed to be allowable as depending from what are believed to be allowable independent claims 1 and 17 for the reasons given above. In addition, claims 7 and 20 recite further limitations that distinguish over the applied art.

In conclusion, it is respectfully submitted that claims 7 and 20 are not rendered obvious by Kressel et al. in view of Mann et al. and are therefore allowable.
Applicant asks that the Examiner reconsider and withdraw the rejections.

CONCLUSION

For at least the reasons set forth above, Applicant respectfully requests reconsideration of the Application and withdrawal of all outstanding objections and rejections. Applicant respectfully submits that the claims are not anticipated by, nor rendered obvious in view of the cited art, either alone or in combination and thus, are in condition for allowance. Thus, Applicant requests allowance of all pending claims in a timely manner. If the Examiner believes that prosecution of this Application could be expedited by a telephone conference, the Examiner is encouraged to contact the Applicant's undersigned representative.

This Response has been filed with a one month fee extension. In the event that Applicant is mistaken in these calculations, the Commissioner is hereby authorized to deduct any fees determined by the Patent Office to be due from the undersigned's Deposit Account No. 50-1059.

Respectfully submitted,

Dated: April 10, 2009

McNees Wallace & Nurick LLC

/Daniel J. Jenkins/

Daniel J. Jenkins
Reg. No. 59,162
100 Pine Street
P.O. Box 1166
Harrisburg, PA 17108-1166
Attorney for Applicant

Phone: (717) 237-5213
Fax: (717) 260-1738